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ABSTRACT

This paper describes the design and implementation of a real time on-line collaboration tool, EDUCO. The main focus is to demonstrate how the tool is applied to a real life on-line distance education course, discuss the preliminary research findings of the qualitative empirical study, propose directions for future work and discuss implications. The preliminary results show that some of the features used in this tool can be directly applied to a wider context of modern computer-based learning environments. (Contains 10 references, 1 table, and 6 figures.) (Author)

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A Tool for Real Time On-Line Collaboration in Web-Based Learning

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Abstract: This paper describes the design and implementation of a real time on-line collaboration tool, EDUCO. The main focus is to demonstrate how the tool is applied to a real life on-line distance-education course, discuss the preliminary research findings of qualitative empirical study, and propose directions for future work and implications. The preliminary results show that some of the features used in this tool can be directly applied to a wider context of modern computer-based learning environments.

Introduction

The main objective of the EDUTECH project is to develop methods for applying probabilistic modeling techniques, such as Bayesian network models, in building and using personalized, adaptive software components for digital learning environments. The research focuses on developing intelligent autonomous but interoperabile modules for educational purposes from assessment techniques to the support of co-operative activities and personalized adaptive learning materials.

The *first phase* of the EDUTECH study period (1999-2000) concentrated on the development of intelligent questionnaire software EDUFORM (Kurhila, Miettinen, Niemivirta, Nokelainen, Silander and Tirri 2001). EDUFORM allows for an adaptive and dynamic optimization of questionnaire propositions and profiling of learners on-line. This software module is applied to varying types of assessment applications both in business and educational domains.

The ongoing *second phase* (2001-2002) of the project has two sub-phases. Firstly the research group has developed an experimental version of a tool for on-line computer supported collaborative learning. The latter ongoing part of the research is focused on utilizing and combining the co-operative aspects of profiling information gained from EDUFORM by providing mechanisms for intelligent matching with co-students.

The major goal of this paper is to describe the design and implementation of a real time on-line collaboration tool, EDUCO. The main focus is to demonstrate how the tool is applied to a real life on-line distance-education course, discuss the preliminary research findings of qualitative empirical study, and propose directions for future work and implications.

The Role of Real Time Interaction in Web-Based Learning

The concept of computer supportive collaborative learning (CSCL) consisting intentional active learning, process aspect knowledge and methods of knowledge-building resources necessitates a flexible and synchronous learning situation (Scardamalia and Bereiter 1994). When we compare these conditions for learning and the implications from CSILE and Knowledge Forum to modern platforms for web-based learning, such as WebCT and Learning Space, we must admit that the real time component of on-line learning process is still very static and inflexible.

How, then, the task-related social interaction, which should play a significant role in a learning process, is implemented in available educational software? Comparison between the software is relatively simple to carry out due to the fact that popular platforms have relatively similar functionality. They all provide the learners with tools to go through the learning material, perform tasks like answering to quizzes and submitting assignments, and communicating with peers or teachers (see e.g. Landon 2001). However, in these "traditional" web-based learning environments the real time social interaction is limited to a simple chat and web board services. When a user is actually using the platform, the learning experience can be perceived as a lonesome activity, since there is no *feeling* of

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other live learners or teachers within the environment. The concept of *social navigation* (Munro, Höök and Benyon 1999) provides one viable solution to the problem.

Considering social navigation from the standard perspective, the concept means providing the users with information from the actions of other users of the environment. For example, showing the hits for different web pages is a simple form of providing means for social navigation. In the seminal book of social navigation, Munro et al. (1999) use an on-line grocery store as an example: if people visiting the store are given recommendations what other people have bought, it is a form of *indirect social navigation*. If a shopper in the grocery store has a sense of other people moving about the store and can engage in seeking e.g. assistance, it is a case of *direct social navigation*.

Experiments with social navigation have mostly fallen into the category of indirect social navigation. Still, in some sense the feeling of other users can be achieved even if the actions are not delivered to other users in real time. For example, in CoWeb (Dieberger 1999) the feeling of *aliveness* is carried out with persistent discussion spaces that allow any user to modify any hyperdocument. CoWeb uses indirect social navigation in generating footprint markers that indicate the amount of recent traffic to pages and when the pages were last modified. The markers provide an additional sense of awareness of activities in the information space and thus increase the sense of the CoWeb as a social "place".

However, the indirect social navigation approach does not add to the need for really *live* users. Therefore, we have implemented a tool for real time on-line collaboration called EDUCO. EDUCO appears to the users as a visual collection of web sites, where the users can navigate the documents and see when other users are navigating those same documents. Users can engage in chat simple by clicking the dots representing users in EDUCO. Furthermore, EDUCO users are able to set "alarms" which are triggered when a certain person, group member (Hoppe and Ploezner 1999) or any user arrives to the systems or to a certain document. Search functions to locate users or documents with desired keywords in the title exist as well.

The Design of the Study

The first experiment with EDUCO was a course given at the Department of Computer Science, University of Helsinki, Finland. The topic of the course was Web-based learning. The first meeting was an introduction to the topic and to EDUCO. The following weekly or bi-weekly sessions were carried out on-line with EDUCO as an interaction tool until the final day when students presented their papers. Students (N=24) taking part of the course were expected to form a group of two, pick a topic in the field of web-based learning and prepare a paper and a presentation about the topic. In addition, there were several time-limited mini-tasks given by the teacher on-line, and tasks where the students were supposed to comment on research papers on web-based learning. The data set was gathered in three stages: (1) Pre test on the first day of the course measured motivational level and learning strategies, (2) user log was gathered during the course, and (3) post test after the course measured how students' expectations faced the reality.

Pre Test

Motivational profiling in this study is based on the Motivated Strategies for Learning questionnaire (MSLQ), which is developed on the basis of motivational expectancy model (Garcia and Pintrich 1994). MSLQ measures both motivational factors and learning strategies and has been adapted to the research field of Finnish vocational and higher education (Ruohotie 2000). The motivation section (A) of the questionnaire consists of 17 items that were used to assess students' value for a course, their beliefs about their skill to succeed in the course, and their anxiety about tests in the course. The learning strategy section (B) includes 13 items regarding student's use of different cognitive, metacognitive and resource management strategies. A 5-point Likert type scale ranging from 1 ("Not at all true of me") to 5 ("Very true of me") was used for all items. Students were divided into three groups based on their motivational level scores from "A" section of the questionnaire: *Group 1* (blue, N=10) characteristics: Extrinsic goal orientation, test anxiety and meaningfullness of studies, *Group 2* (green, N=8) characteristics: Efficiency beliefs, intrinsic goal orientation and meaningfullness of studies, *Group 3* (red, N=6) characteristics: Control beliefs and intrinsic goal orientation.

Data Collection During the Course

User log from EDUCO (time stamp, user id, action) was recorded during the course from September 24 to November 20, 2001. (Figure 1).

```
12:25 1.10.2001;user1;login;
12:30 1.10.2001;user1;search;AI
12:31 1.10.2001;user1;get;http://www7.scu.edu.au/programme/fullpapers/1893/com1893.htm
12:41 1.10.2001;user2;comment;cmts47.html
12:42 1.10.2001;user3;alarm;user1,http://www.cs.pitt.edu/~chang/bookdb/GrowingBook.htm
```

Figure 1: A sample of EDUCO log file.

Post Test

An email survey consisting of 15 open propositions (10 responses out of 24) was conducted two weeks after the course in December 2001. Propositions measured users experiences and expectations towards computer supported education together with EDUCO-related attributes (usability issues, user interface, features etc.).

EDUCO Architecture

From a technological point of view, EDUCO consists of a server, a Java applet for every user and several cgi-scripts. The server tracks the state of the distributed system and informs the clients as changes occur. Examples of possible changes in the environment are users moving to another page and initiating a chat. The implementation of this kind of a scheme in real time requires the clients to maintain an open connection to the server throughout the session.

To avoid any copyright or other intellectual property right issues we have taken the approach that the documents (i.e. HTML-files) chosen to be part of a particular instance of EDUCO are not copied to our server. Instead, they can be located anywhere on the Web. This being the case, the server needs to know which page each user is viewing. We have solved this problem by using our EDUCO-server as a kind of proxy, which means that the documents are routed through our server instead of being sent to the client directly from their actual location (Figure 2).

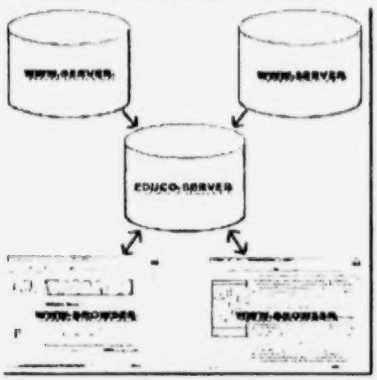

Figure 2: Data flowin EDUCO.

EDUCO User Interface

The EDUCO user interface consists of six elements of which only one is concurrently visible: (1) Map, (2) Chat, (3) Search, (4) Alarm, (5) Preferences and (6) Help. The EDUCO interface is small, only 200 x 300 pixels, and thus placed into the left-hand side of a www-browser frameset. The right-hand side of the browser frameset, usually more than 440 pixels, is reserved for the content (i.e. hyperdocuments) and the space below EDUFORM is reserved for the document specific comments. Commenting is based on ordinary html-forms. Each document has an associated comment file, which is opened to its designated frame and can be updated by the users. The server keeps track of modifications and the visits of individual users. This way the documents that have been commented after the last visit can be distinguished visually from those that contain only comments the user has already seen. (Figure 3.)

"Map" is a view to a visualization of the hyperdocument structure and the people present in the learning environment. The material is organized in clusters consisting of related hyperdocuments. People are shown as coloured dots. Colour indicates different group membership or types of user

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profile, and the location of the dot depends on the document the person is currently viewing. When mouse is placed on top of the symbol of document or person, a tool tip appears showing the name of the person or the document. Clicking a symbol selects it for further use; double clicking a document opens it in the browser window. The documents change their colour on the map depending on how much they have been read relative to the others. The total time all users have spent reading each document is recorded by the server on an hourly basis. The change in the colour of an individual document is determined by the distance of its moving average for the last 24 hours from the same average for all documents. (Figure 4.)

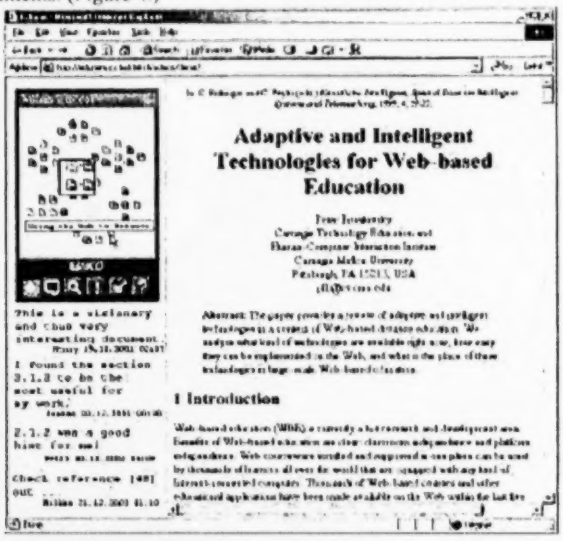

Figure 3: EDUCO user interface with Map view active and open document with related comments.

"Chat" enables synchronous communication with other peers. EDUCO Chat sends messages only to those people sender has actively contacted by e.g. clicking dots on the Map. The number of participants in the discussion is unlimited, but one person may use only one chat channel simultaneously. (Figure 4.)

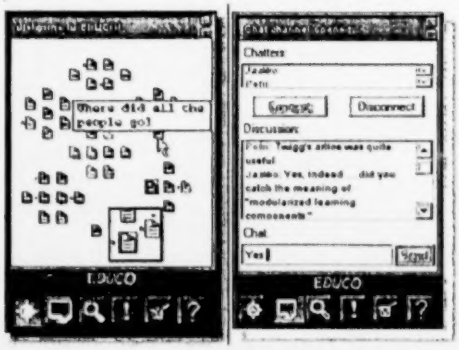

Figure 4: EDUCO Map (left) and Chat (right) views.

EDUCO "Search" is useful for finding people or documents. The search is targeted to the titles of documents and names (and nicknames) of users online. Search selection affects also to the other views ("Map", "Chat" and "Alarm"). "Alarm" defines a condition to be monitored by the system. If a user wishes to seek for a work mate who is also interested in certain document (or topic), he can tell the system to send a notifying message to the title bar of EDUCO when predefined conditions are met, i.e. other person arrives to the document specifying the task. Alarm is helpful when user wishes to conduct a collaborative time-related assignment with a friend who has not yet logged into the system. See Figure 5 for screen dumps of Search and Alarm views.

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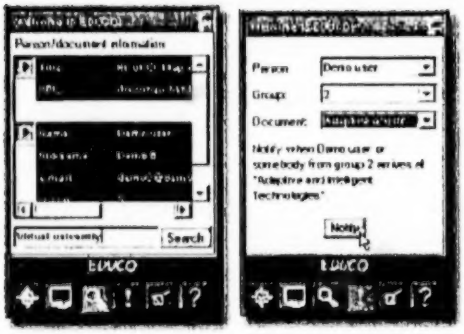

Figure 5: EDUCO Search (left) and Alarm (right) views.

On the "Preferences" view the user is allowed to change personal settings i.e. what is the preferred nickname, is he or she visible to other users (and vice versa) or is the chat enabled. Help view provides information about the program. (Figure 6.)

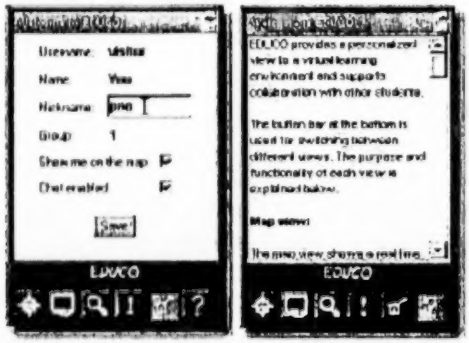

Figure 6: EDUCO Preferences (left) and Help (right) views.

Results

The main focus of this study is on the design and implementation of EDUCO software and thus profound analysis of the empirical results of all three forementioned stages is unbearable to carry out. Next we will present some preliminary results of the post test. Seventeen respondents (71 %) out of 24 replied to the email survey. In this paper we analyse briefly following four propositions (Table 1):

Table 1: Selection of preliminary propositions of the post test.

5. What is your opinion of the essential added value of EDUCO compared to traditional computer-based learning?
9. Give your comment on the Map view's functionality considering it as a tool for a) navigating from one hyperdocument to another, b) commenting (annotation) hyperdocuments, and c) social navigation and interaction.
10. How relevant the Chat was to you?
11. What was the relevance of EDUCO's profiling info to you when you were seeking for work mate(s) to carry out collaborative tasks?

Preliminary results of the post testing show that the EDUCO was found to be a useful tool in the matters like adaptation to respondents learning, cognitive and motivational strategies, and means to implement collaborative actions.

> *"It was very useful to see what documents other users were reading ... it gave me many hints and saved time."*
>
> *"It was truly nice to be able to see what is the most interesting document at the moment and who is reading it."*
>
> *"Actually, in several cases I wanted to start a chat conversation with someone reading same hyperdocument with me ...I guess this is social navigation?"*

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Presence of EDUCO increased task-related participation and was valued tool for those who had difficulties to participate in face-to-face meetings:

"Learning material was easy to access."
"EDUCO gives more flexibility to studying process."
"It was possible for me to participate to this course and carry out all those tasks regardless of my domicile."

Real time interaction of EDUCO also elicited negative comments:

"EDUCO hindered formation of REAL social contacts!"
"Chat never beats traditional face to face meetings."

EDUCO's tools for seeking work mates (group membership, search function) were truly useful for most of the respondents:

"I was in a blue group, and when another blue was looking for a mate, I replied instantly. He had already chosen an article, I glanced at it and found that it was suitable for me too."
"I had a group proposal via email message. As my forthcoming work mate had the same colour than I did, it was easy to make the decision to start collaboration. Afterwards I thought that I agreed so quickly because of the same motivational group, normally it takes more consideration. But to be honest, the topic was the most important factor."

Conclusions

The paper has described the design and implementation of a real time on-line collaboration tool. EDUCO was build to seek solutions to some unsolved problems concerning real time collaboration between live users in both traditional and modern web-based education platforms. The main focus of the study was to demonstrate how EDUCO was applied to a real life on-line distance-education "Web-based learning" course. The preliminary research findings of small-scale qualitative empirical study indicated that some of the features used in this restricted evaluation task, namely "motivational group membership information", "graphical view to the hyperdocument space", "hyperdocuments that change their colour depending on the popularity", can be directly applied to a wider context of modern computer-based learning environments (see e.g. Dillenbourg 1999).

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